

# How to find a planet?



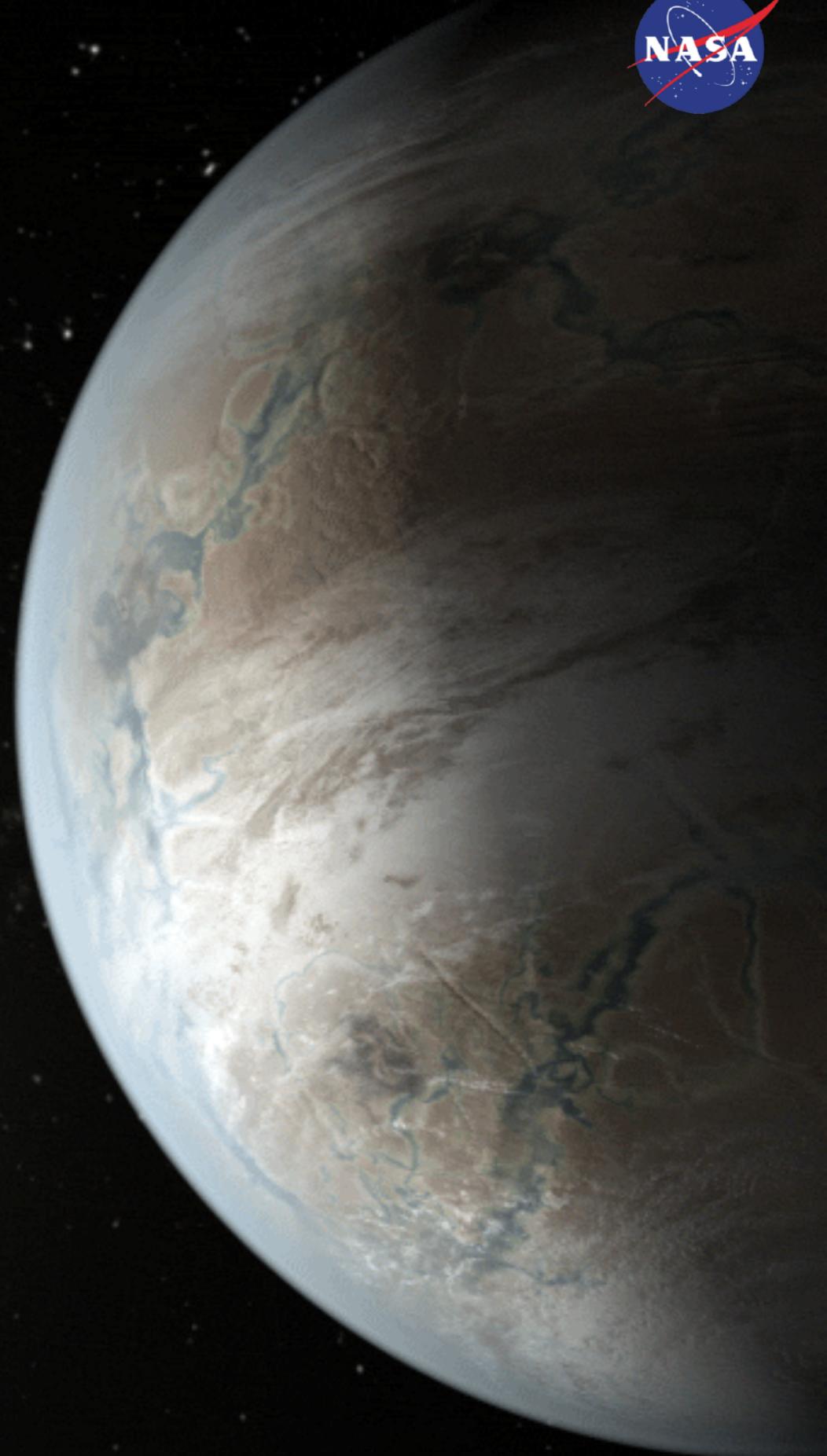
(Not what the actual data look like)

Geert Barentsen

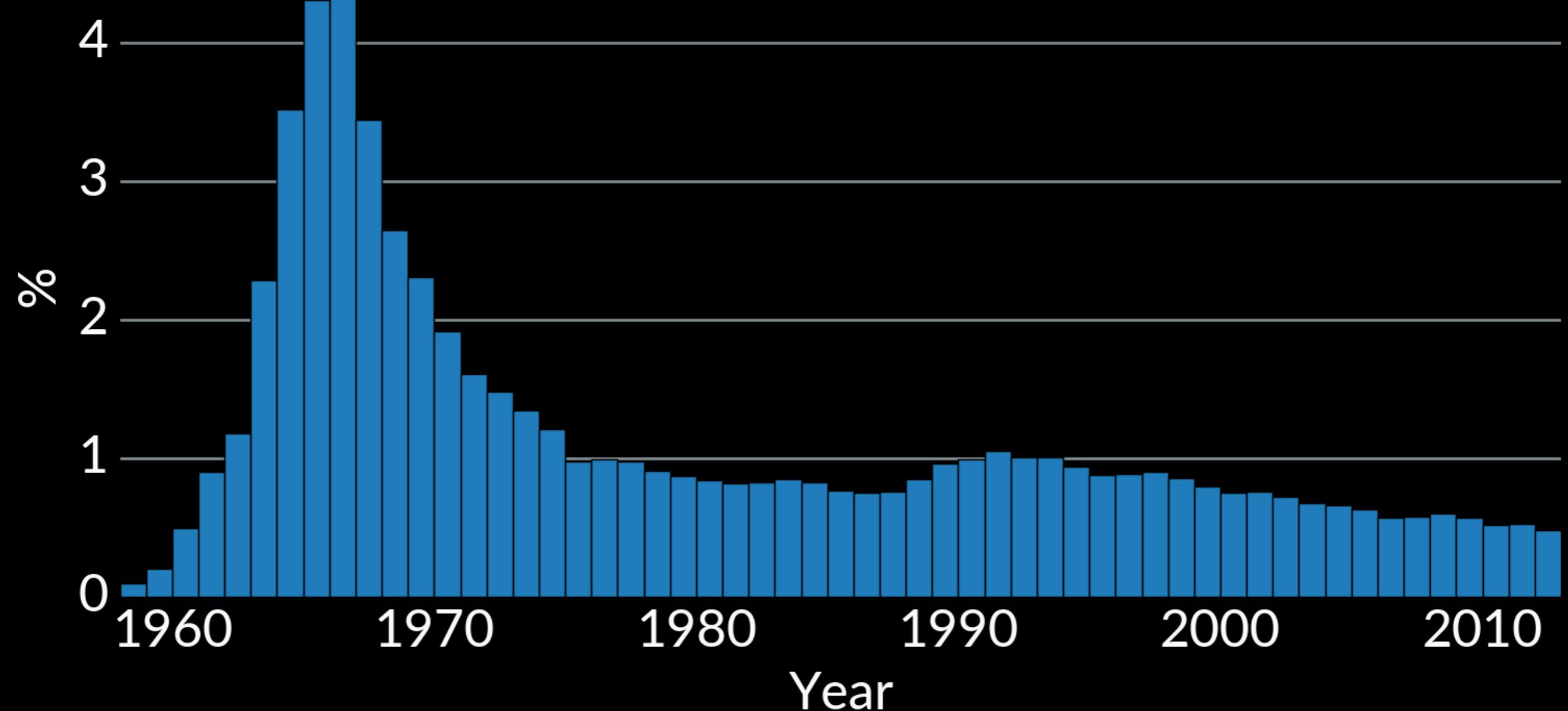
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# NASA Budget as a Percentage of the US Federal Budget



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# STARGAZING LIVE

With Brian Cox & Julia Zemiro



Aired on: Friday 7 Apr 2017, 2:00pm RPT

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Professor Brian Cox and Julia Zemiro will be joined by scientists and personalities to inspire Australia to explore our solar system. Live from Siding Spring Observatory they will tackle astronomy's most intriguing questions.







X Exoplanet Explorers – Zooniverse https://www.zooniverse.org

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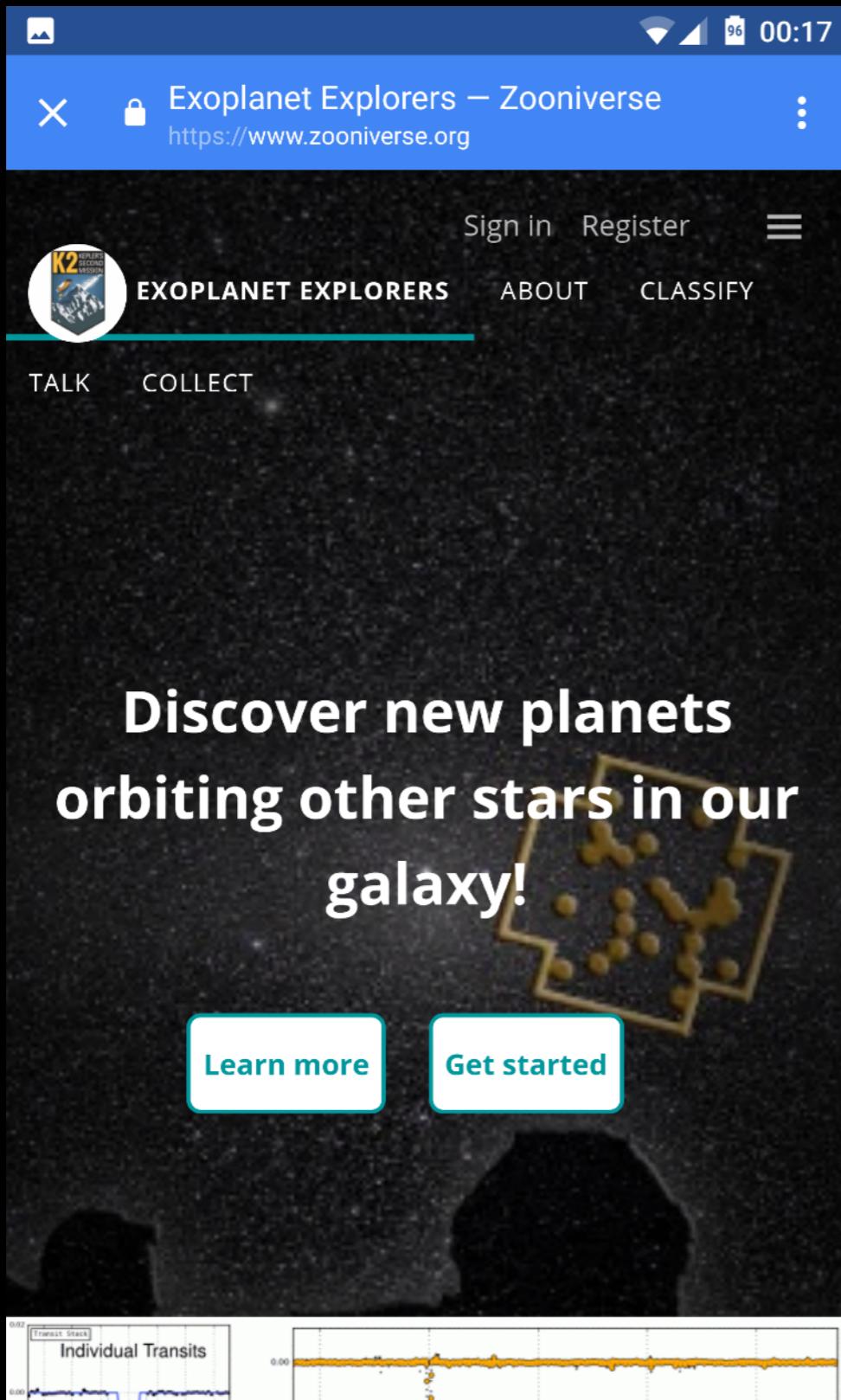
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X Stargazing Live: The Top End m... mobile.abc.net.au ⋮

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**Stargazing Live: The Top End mechanic who found a four-planet solar system**

DIJANA DAMJANOVIC

FRI APR 07 17:02:44 EST 2017





PHOTO The 26-year-old has found four previously unknown planets



LIVE  
ABC  
HD



Siding Spring Observatory



Darwin, NT

# How to find a planet?



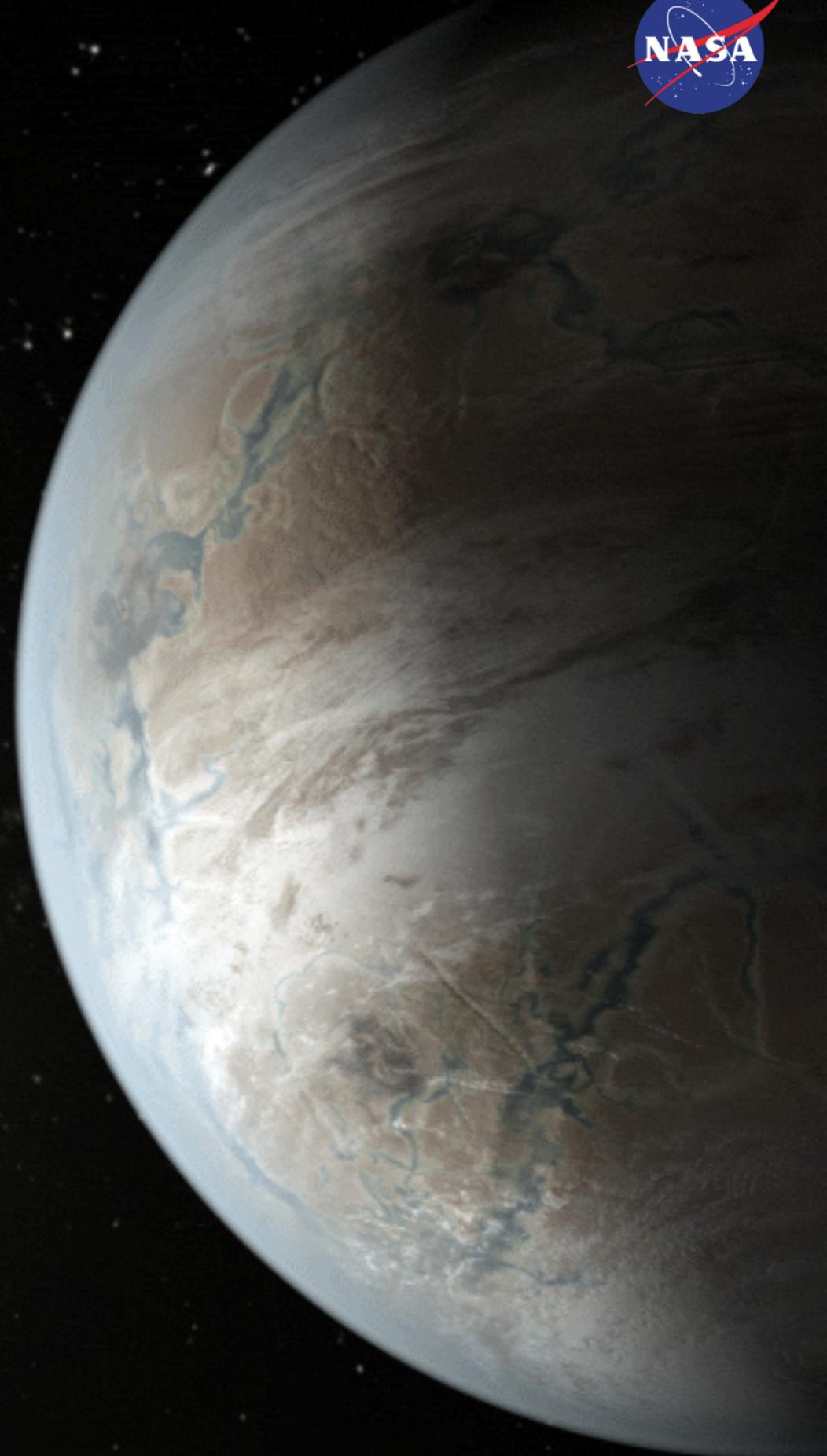
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*Are we alone?*



# PROJECT CYCLOPS

A Design Study of a System for Detecting Extraterrestrial Intelligent Life

(NASA-CR-114445) PROJECT CYCLOPS: A  
DESIGN STUDY OF A SYSTEM FOR DETECTING  
EXTRATERRESTRIAL INTELLIGENT LIFE  
(Stanford Univ.) 253 p

N73-18822

CSCL C3B

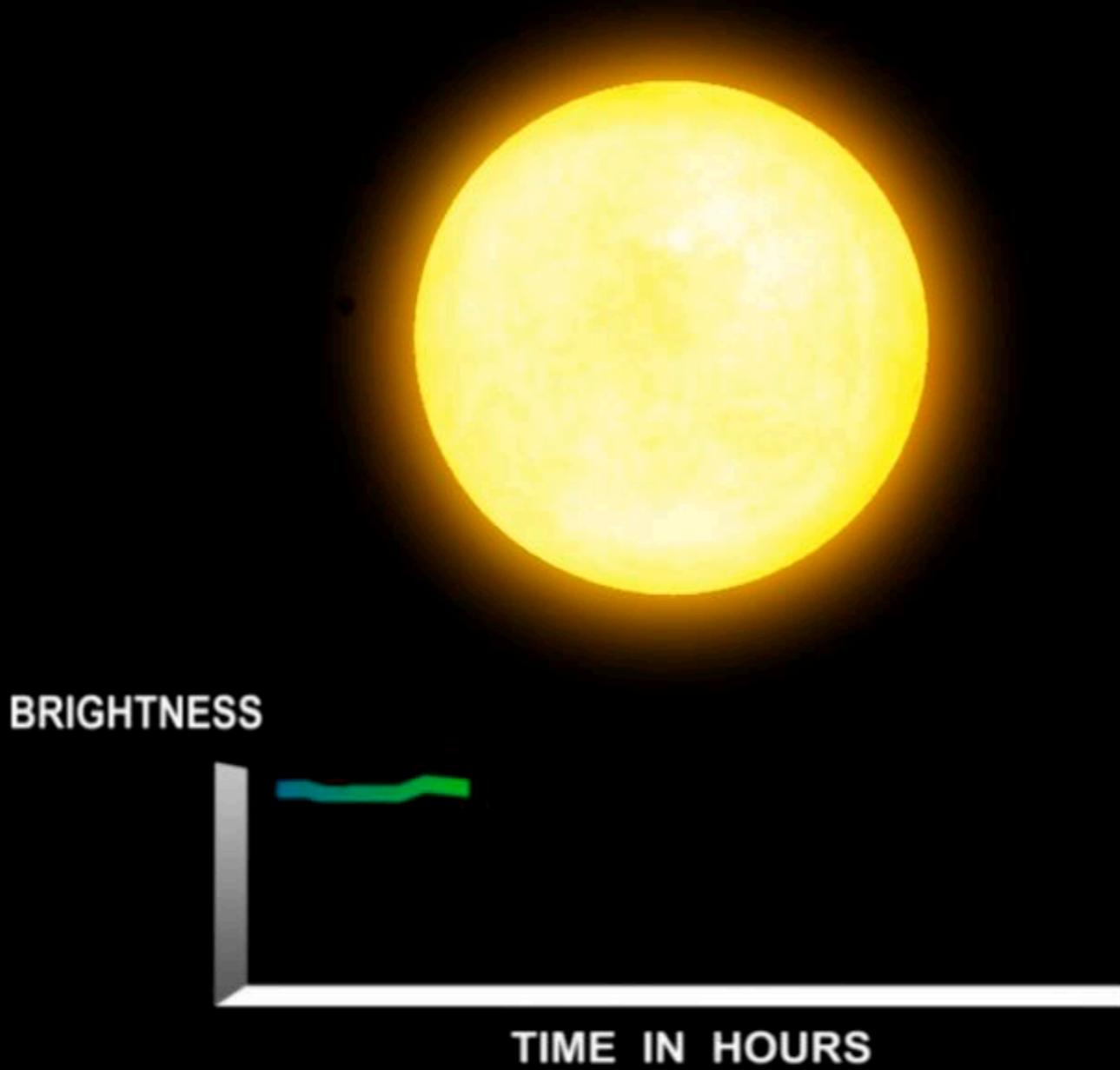
00/30 Unclassified  
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PREPARED UNDER STANFORD/NASA/AMES RESEARCH CENTER  
1971 SUMMER FACULTY FELLOWSHIP PROGRAM IN ENGINEERING SYSTEMS DESIGN  
CR 114445 Available to the public

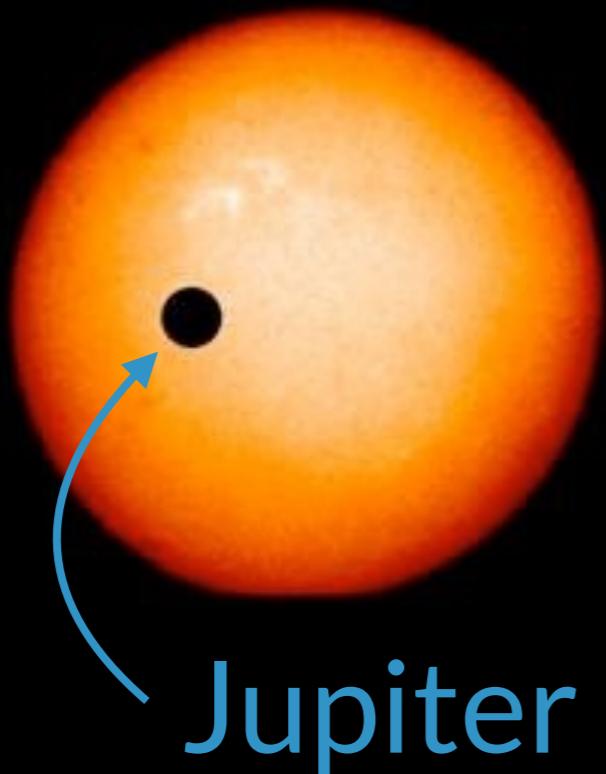
IMI 20120605\_220036\_UTC

Image: NASA

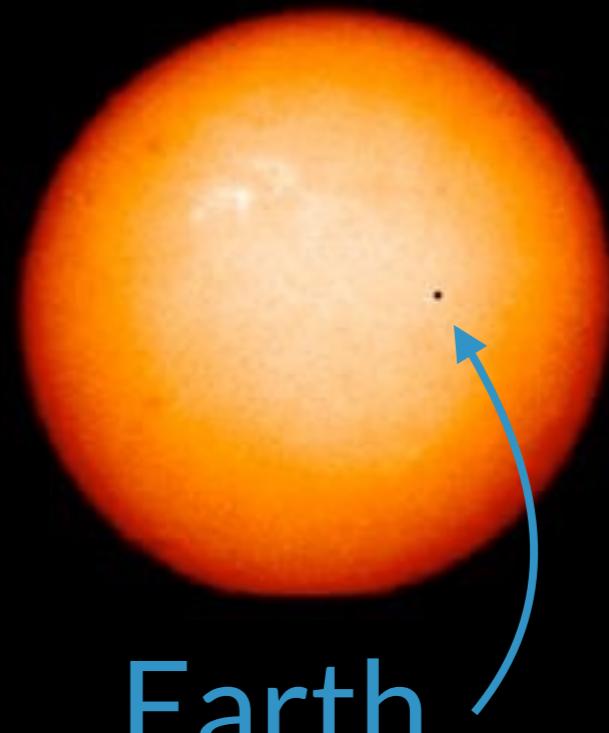
# *Detecting Planet Transits*



*Small planets are really hard to find*

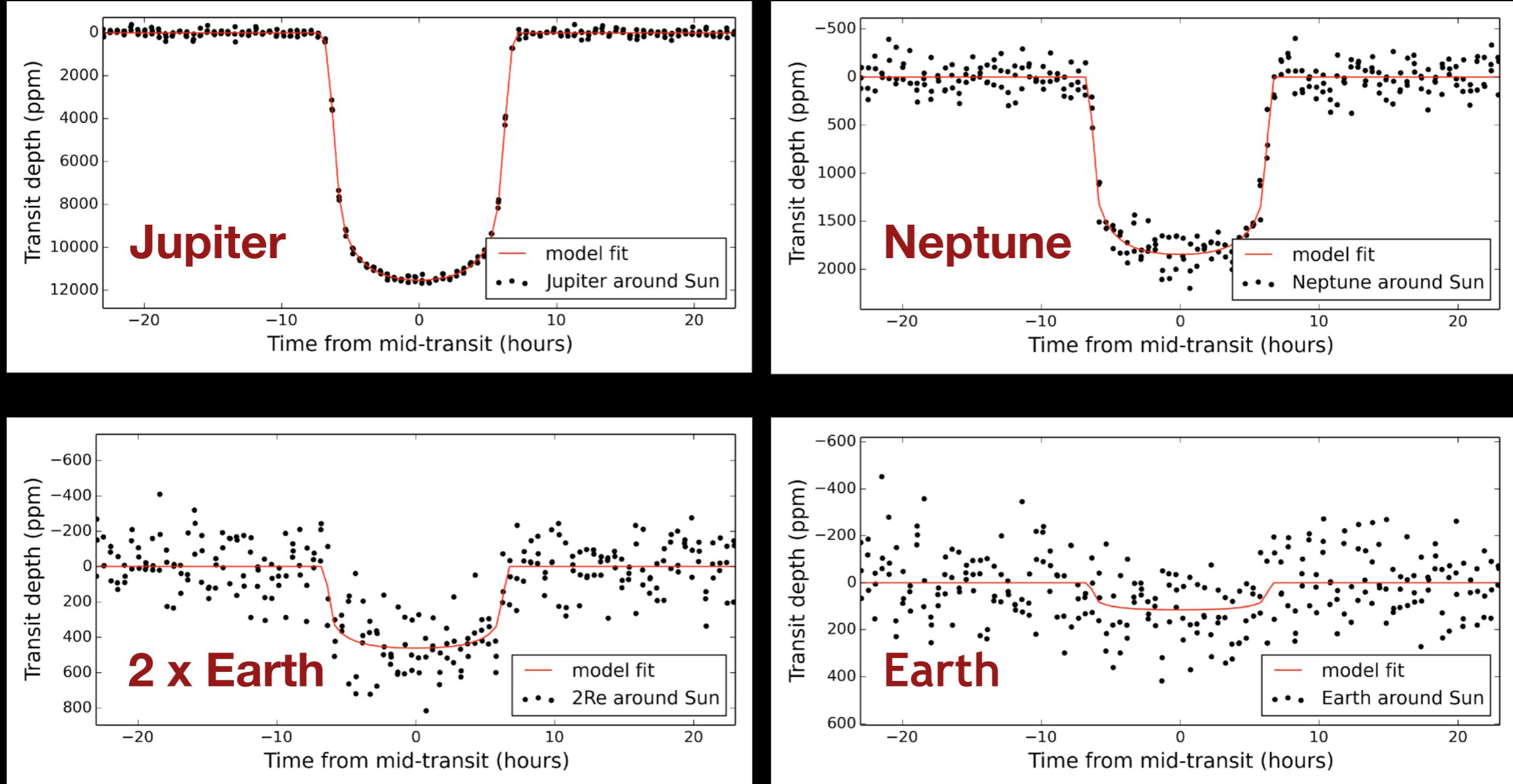


Jupiter



Earth

# *Small planets are really hard to find*

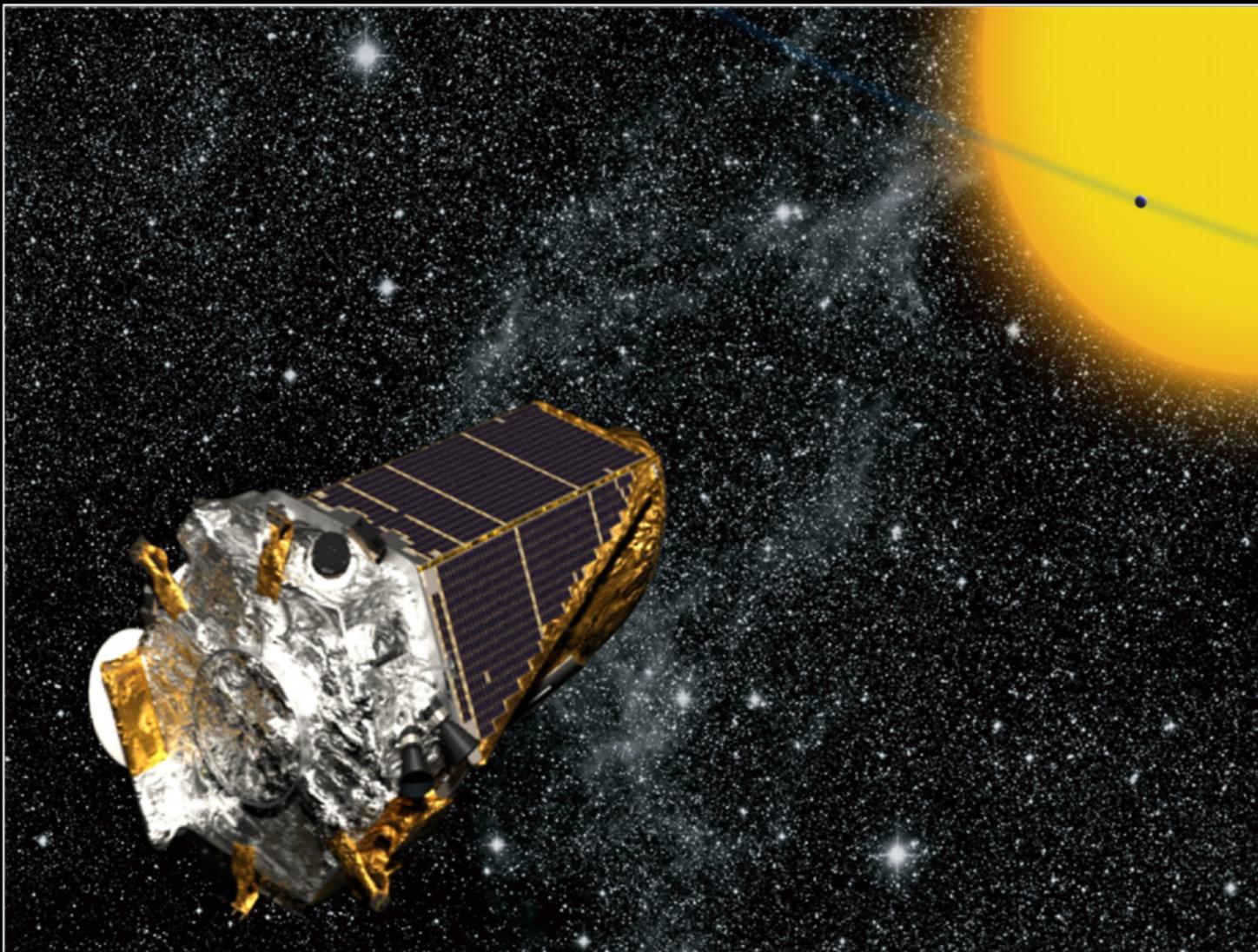


*need to look at **the right place**  
at **the right time***

*and measure the brightness of stars  
**with extreme accuracy***

# NASA's Kepler Mission

Are Earth-like planets common?



# The Kepler Spacecraft

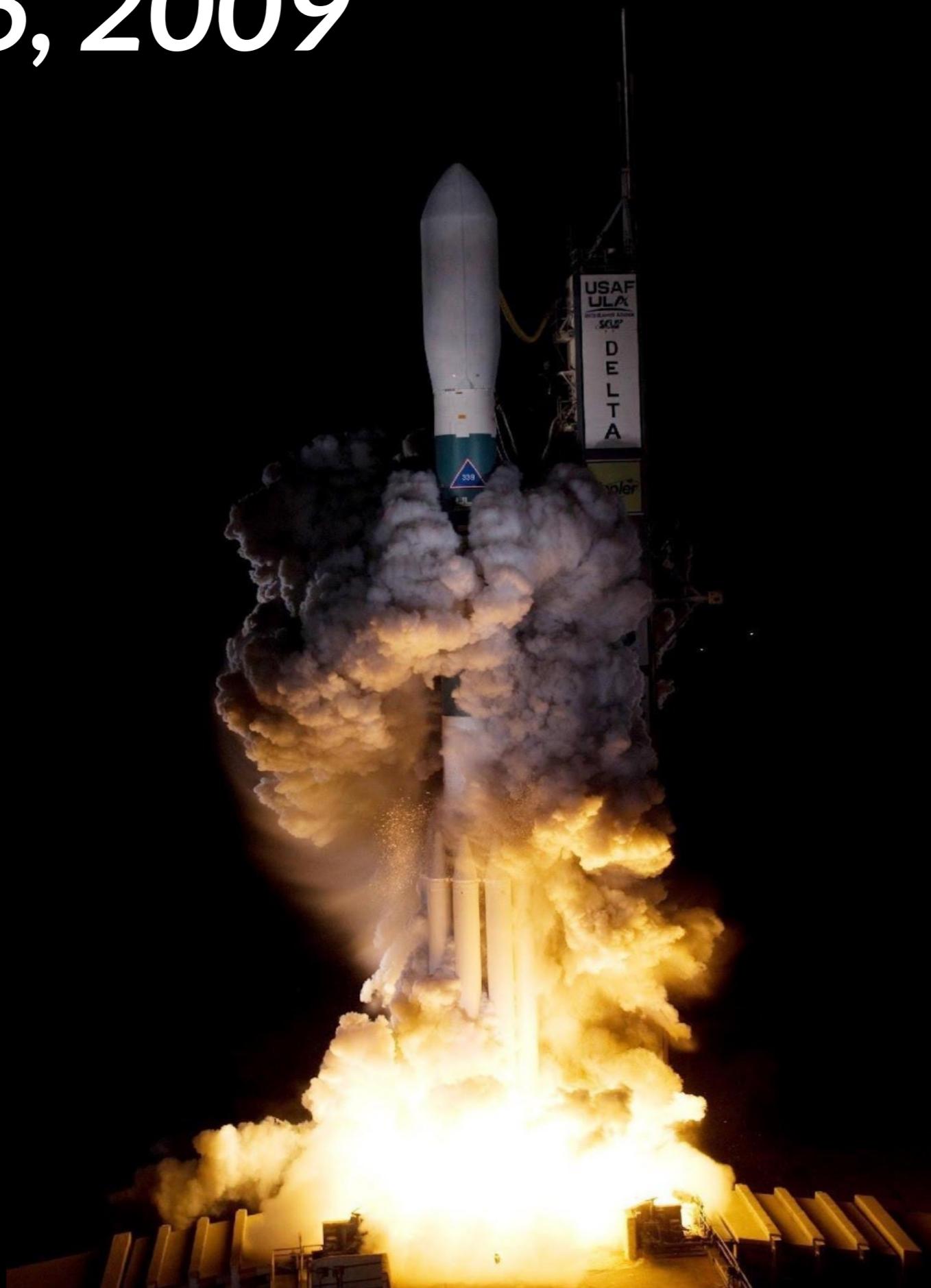


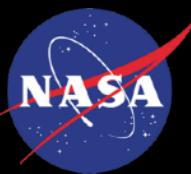
100 megapixel camera ( $100 \text{ deg}^2$ )  
1 or 30 min cadence  
wide passband (V+R+I)



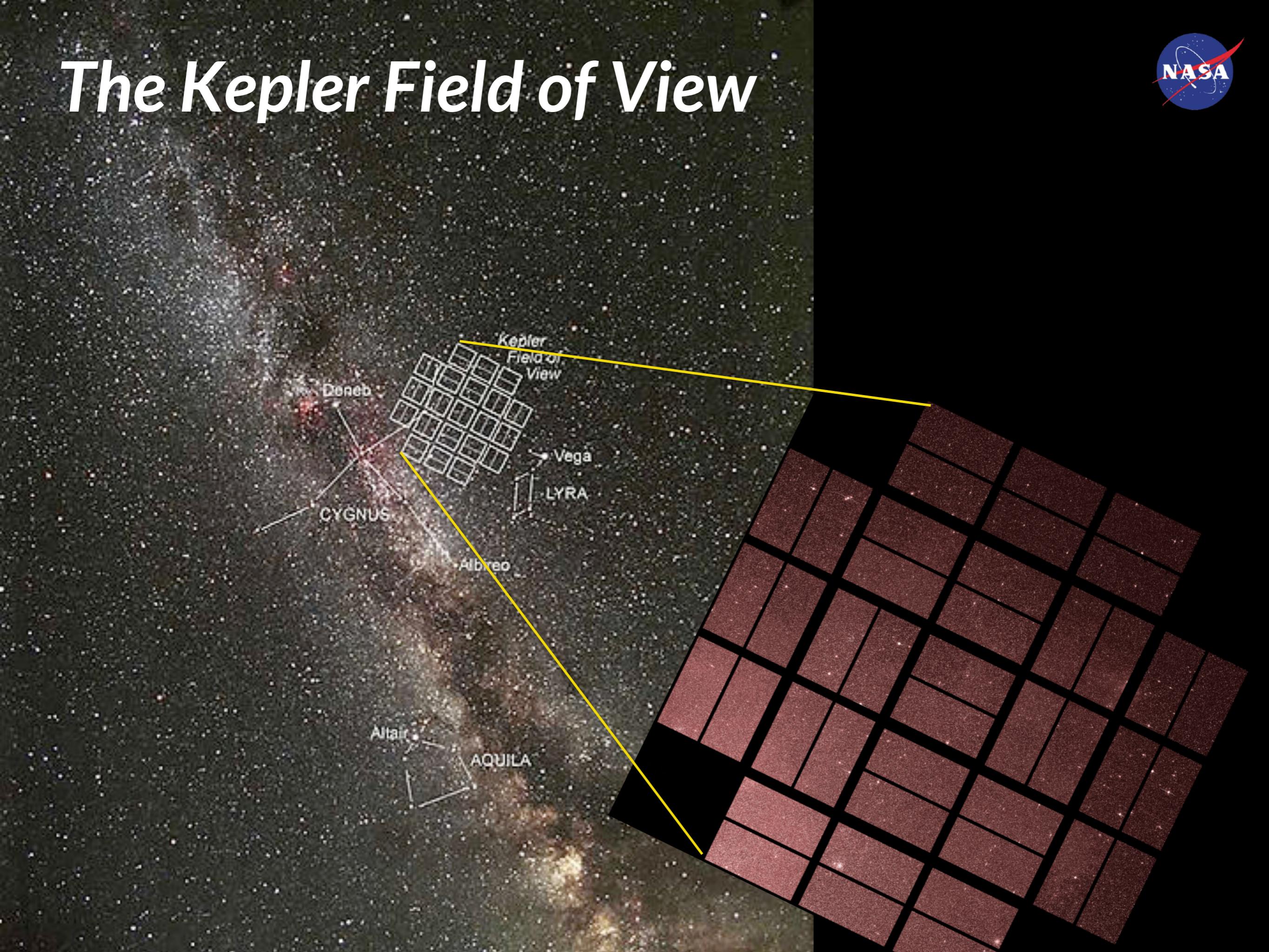
0.95-m Schmidt telescope

# March 6, 2009

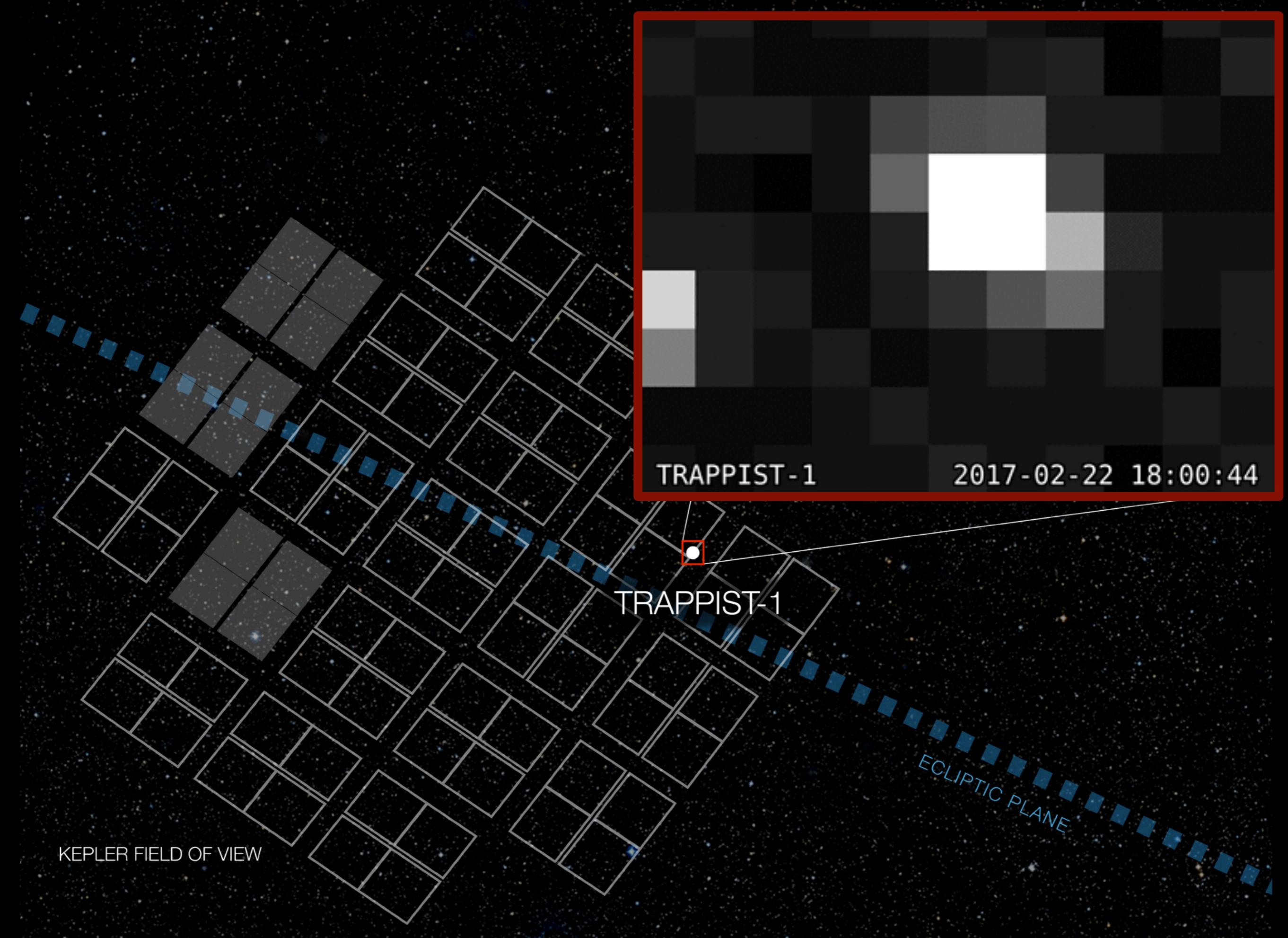




# The Kepler Field of View

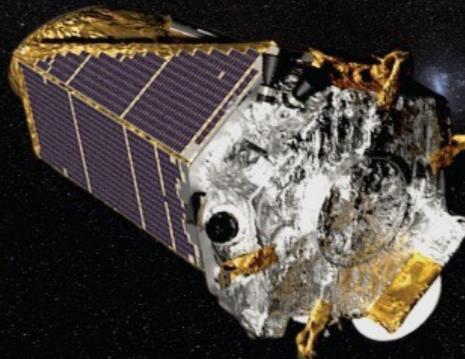


*So what does **the data** look like?*



*Kepler observed 200,000 stars over 4 years,  
finding 4,496 candidate planets*

2009-2013



# And then it BROKE



Space.com NEWS TECH SPACEFLIGHT SCIENCE & ASTRONOMY SEA

Space.com > Science & Astronomy

## Planet-Hunting Kepler Spacecraft Suffers Major Failure, NASA Says

By Mike Wall, Space.com Senior Writer | May 15, 2013 03:44pm ET

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A large image of the Kepler space telescope in space, showing its solar panels and the Earth in the background.

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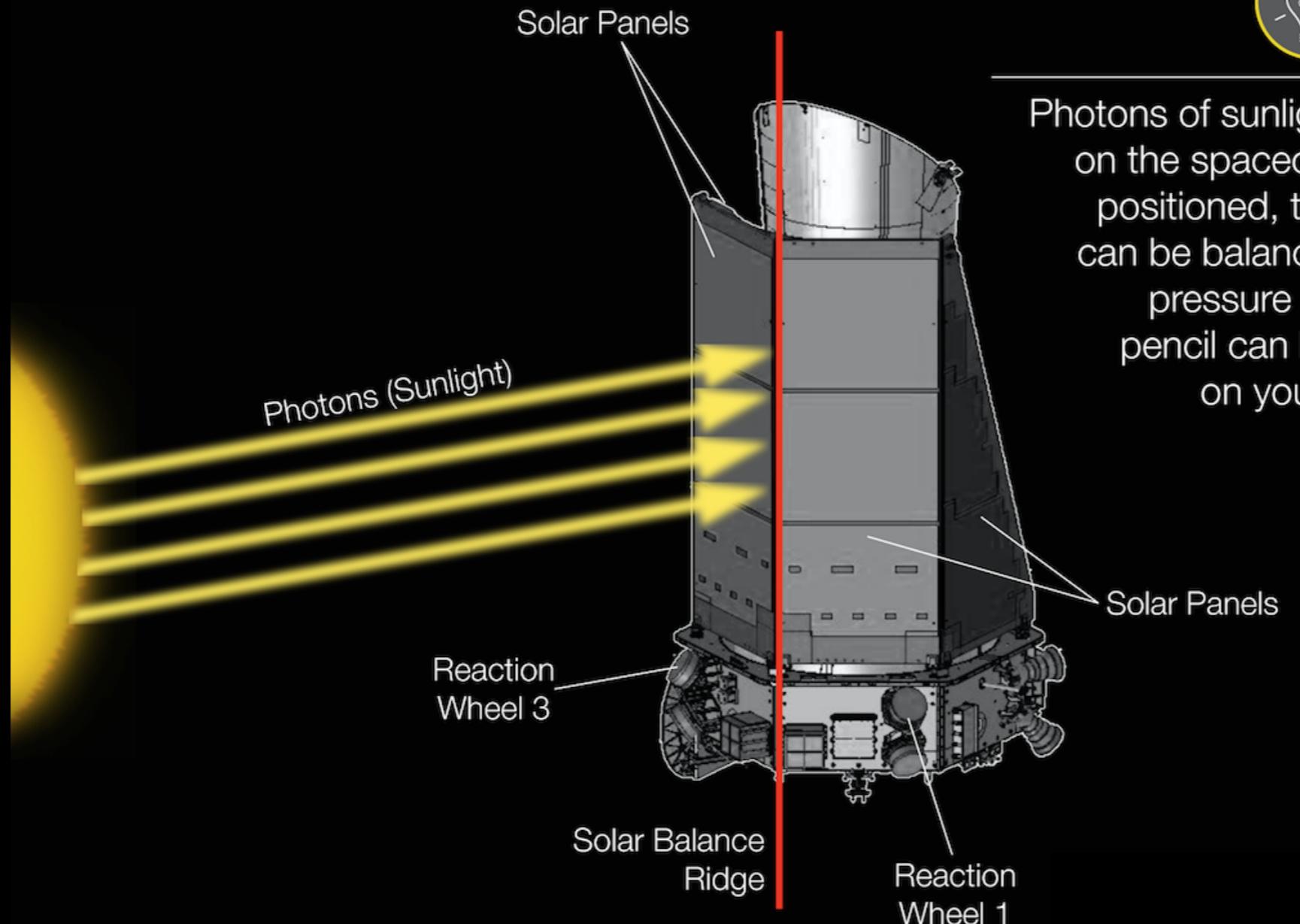
## RIP Kepler: NASA gives up fixing the planet-hunting space telescope

By Sebastian Anthony on August 16, 2013 at 7:32 am | 16 Comments

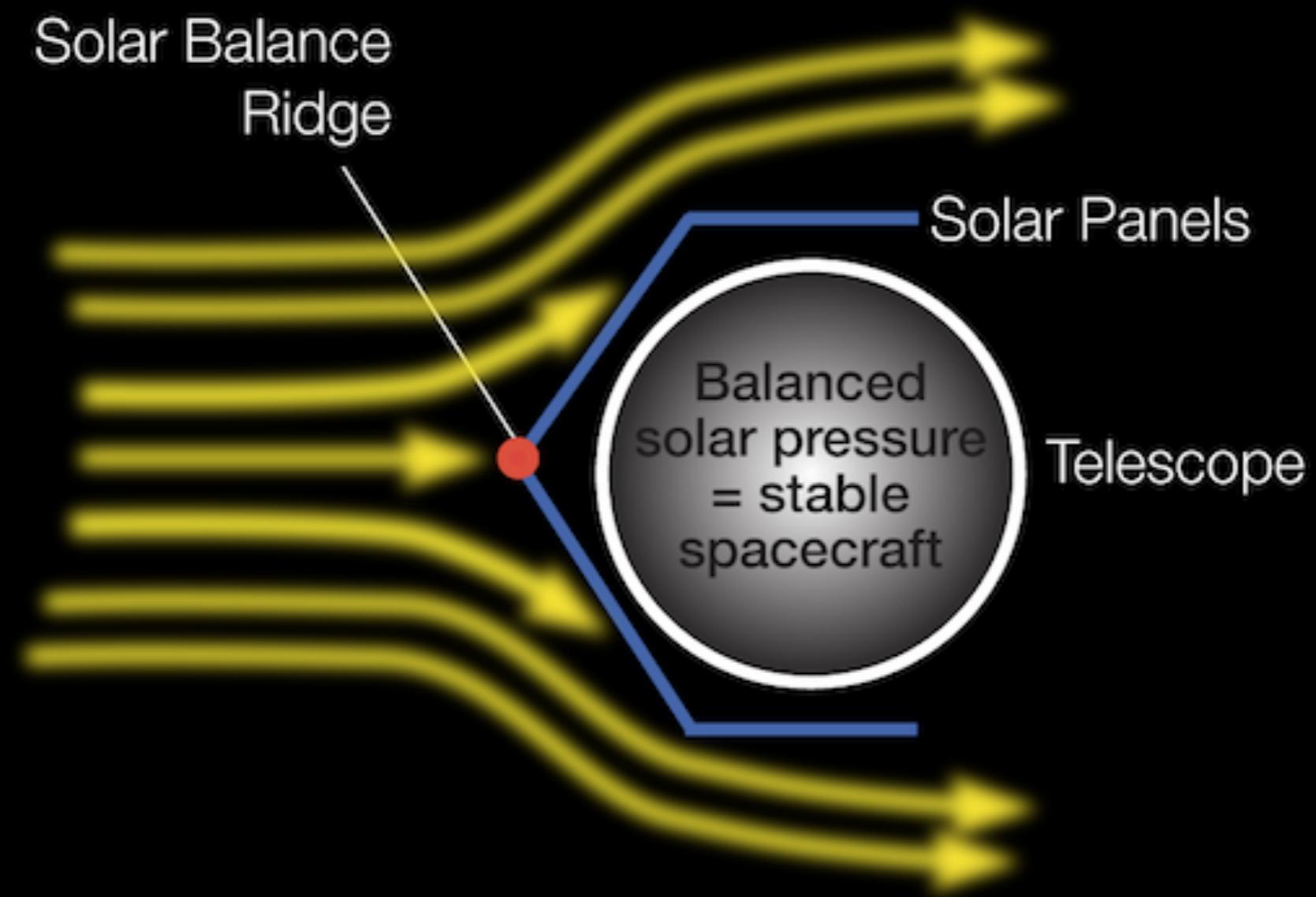
67 shares f t G+ r Y

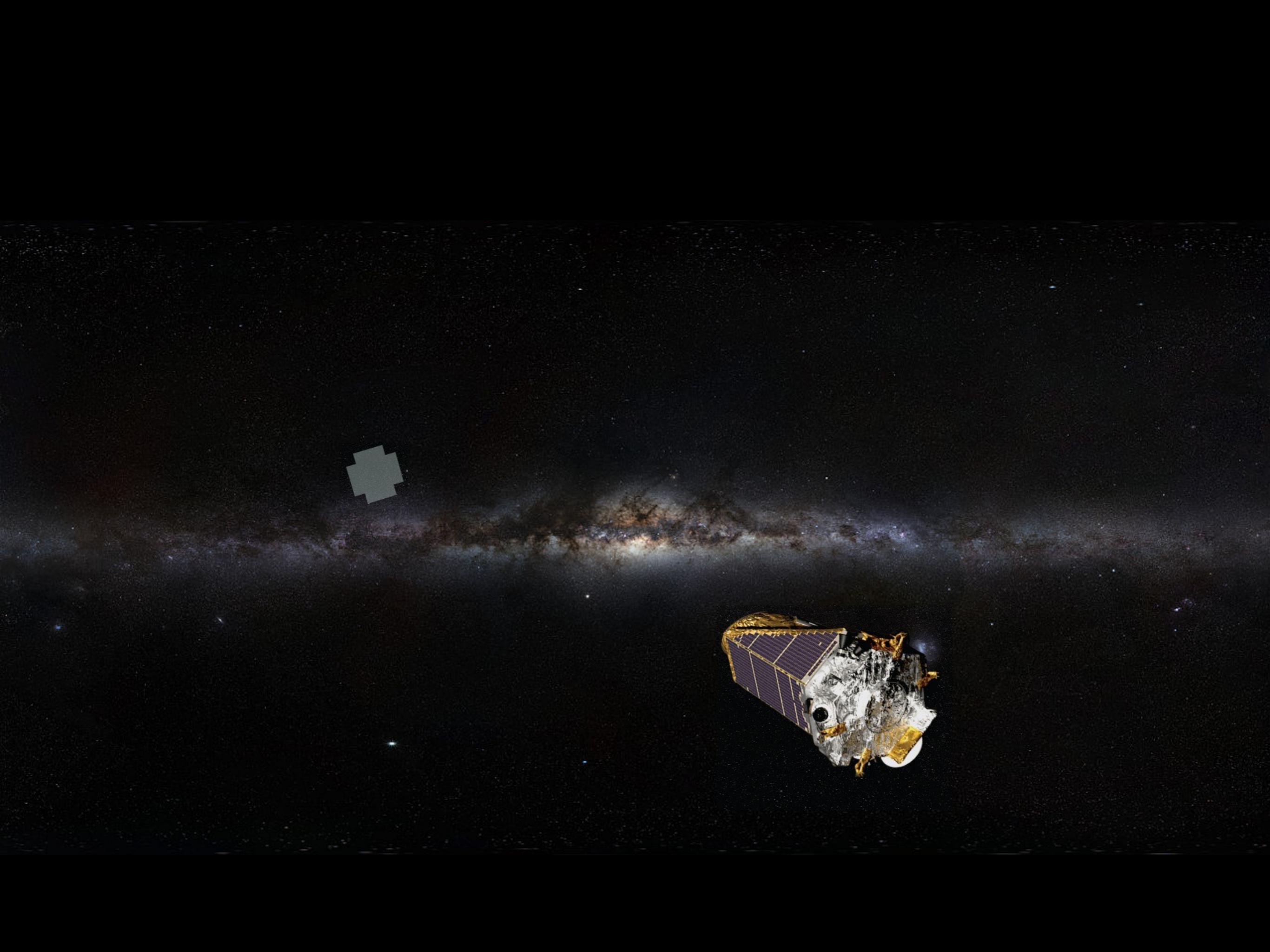


# Balancing Solar Pressure

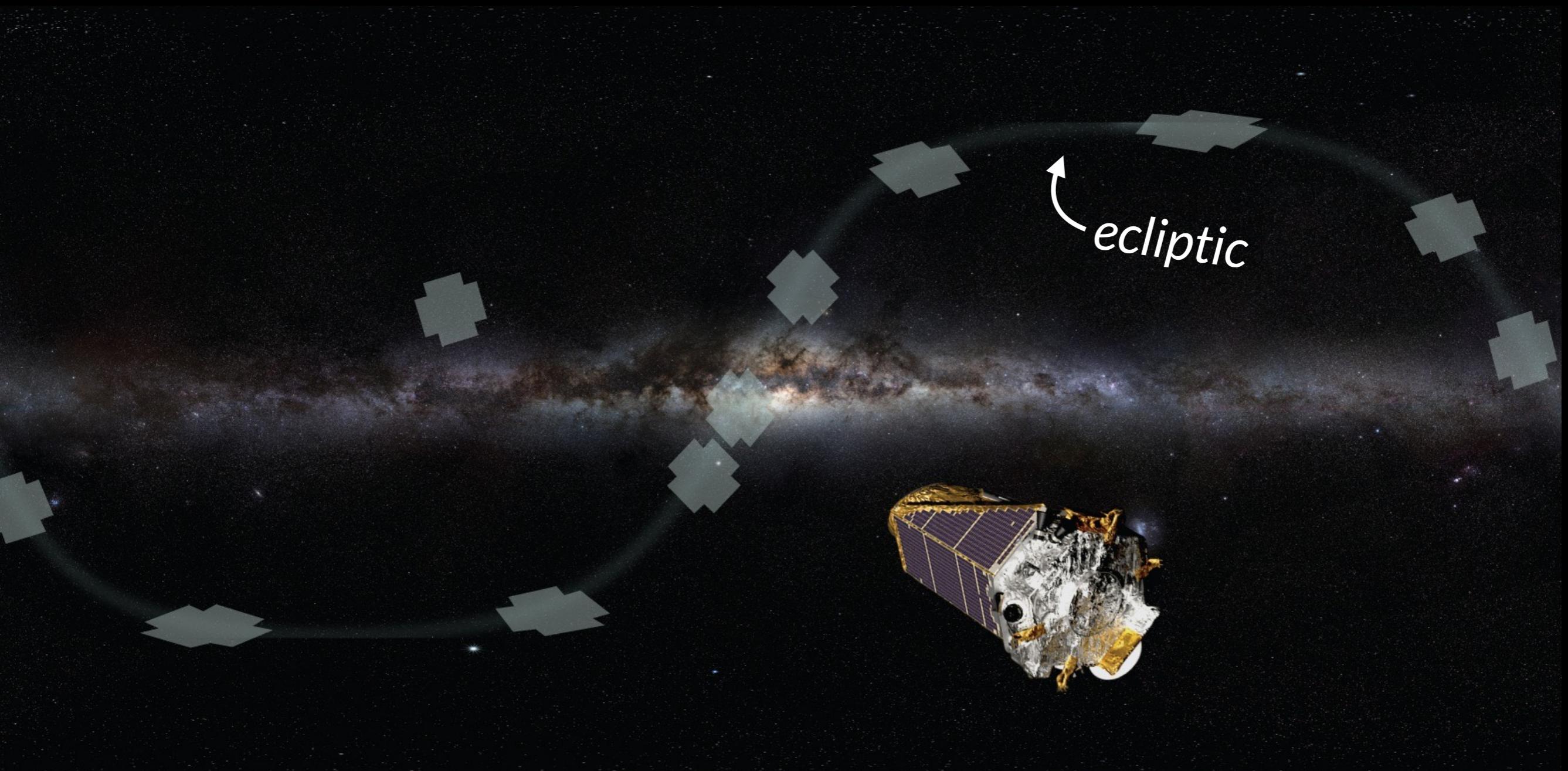


Photons of sunlight exert pressure on the spacecraft. If properly positioned, the spacecraft can be balanced against the pressure much as a pencil can be balanced on your finger.



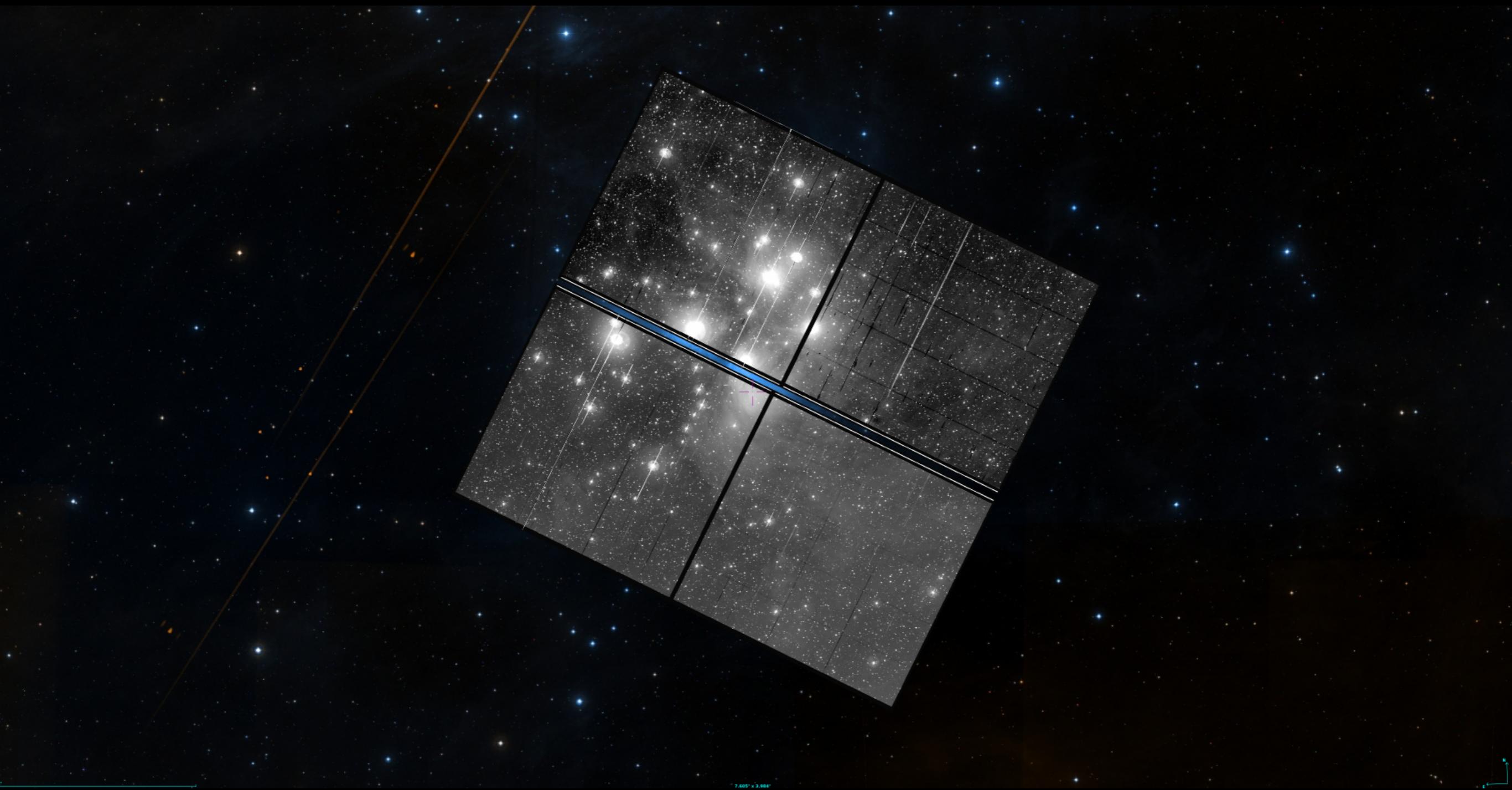


# Kepler now changes its pointing every 3 months

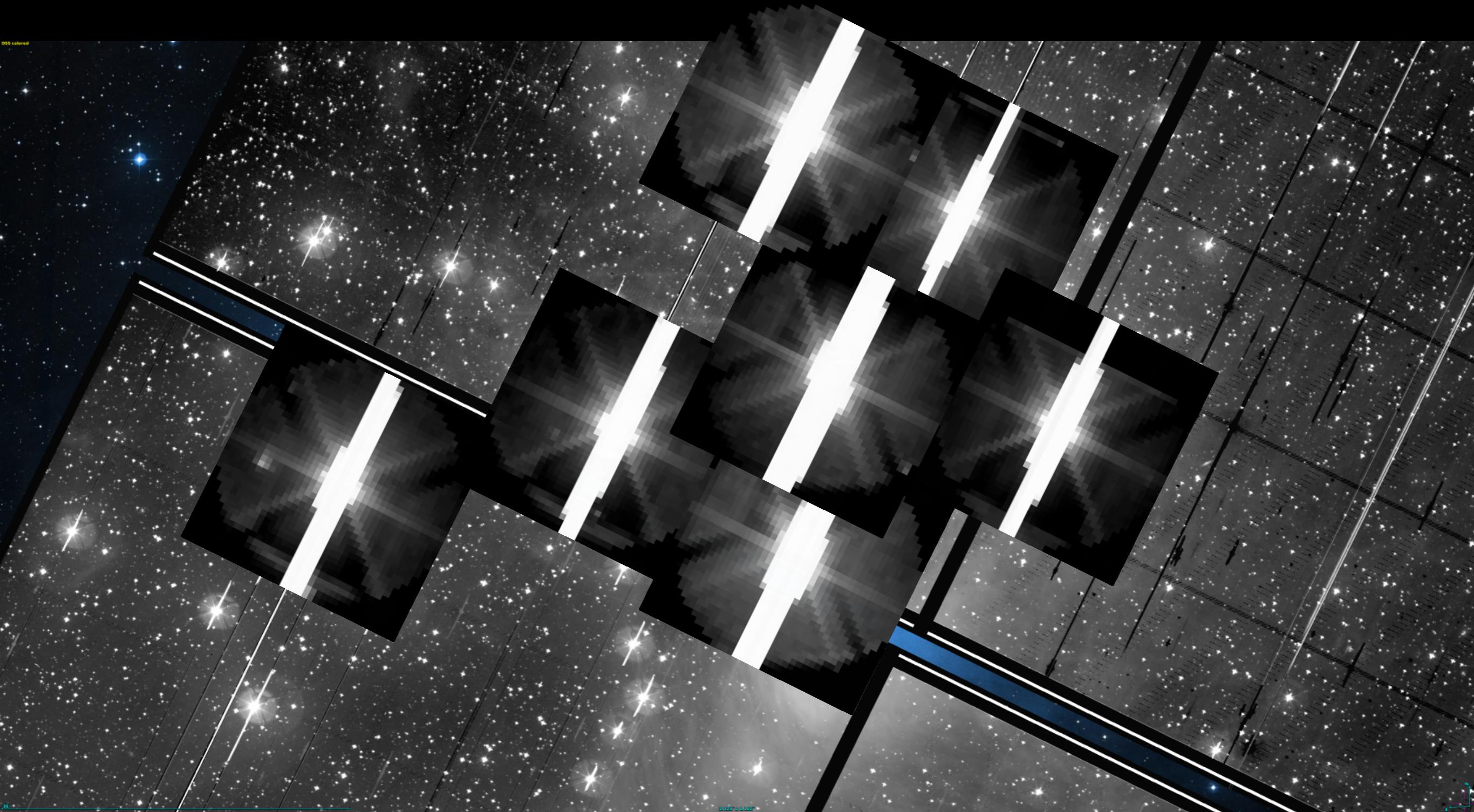


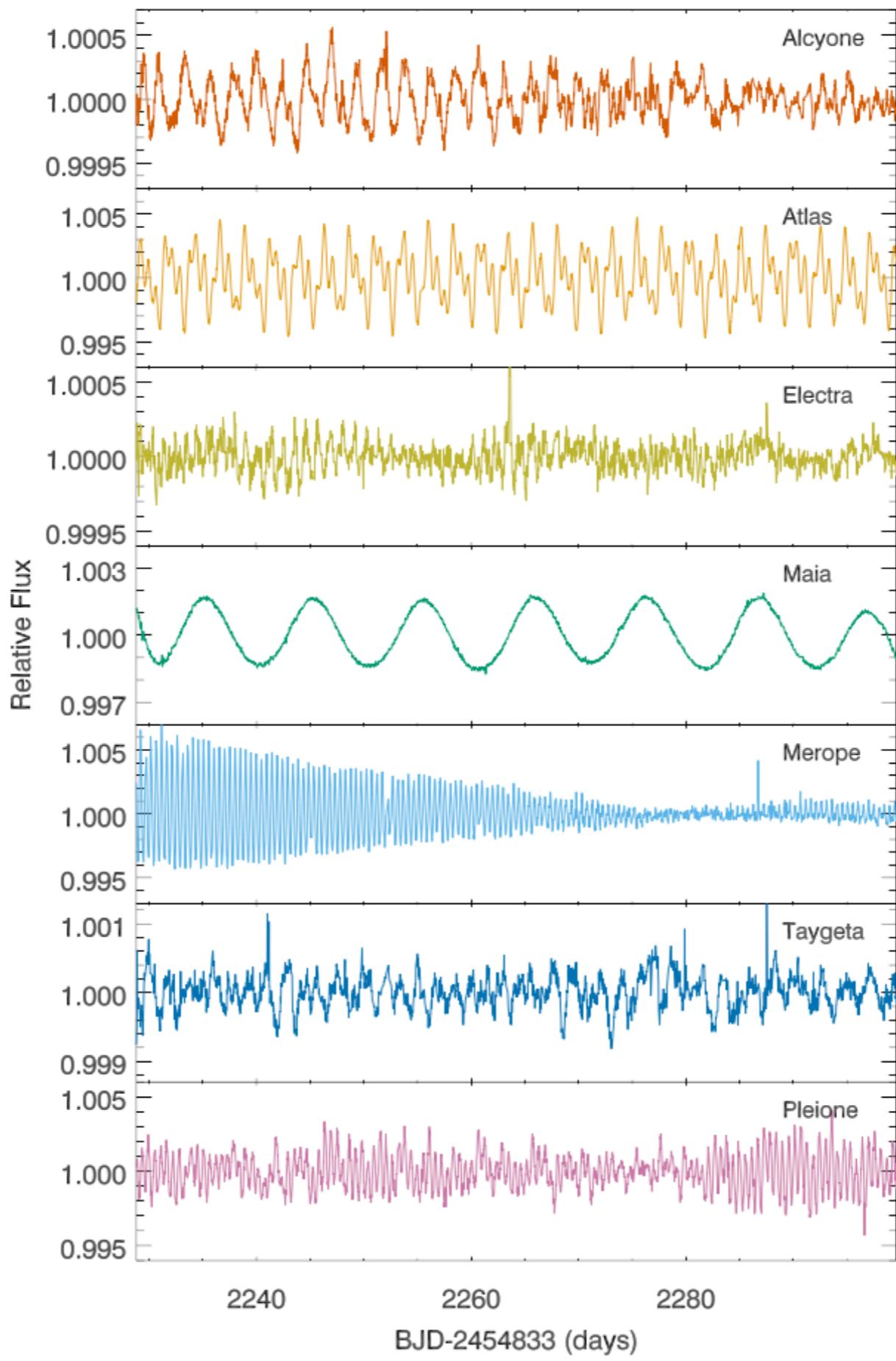
This is called the **K2 Mission**

# The Pleiades

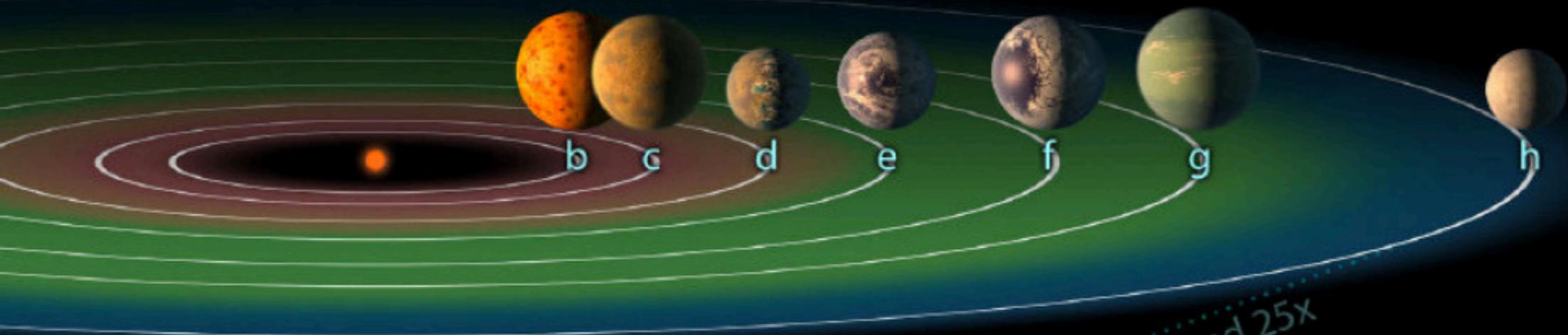


# Photometry of the Seven Sisters

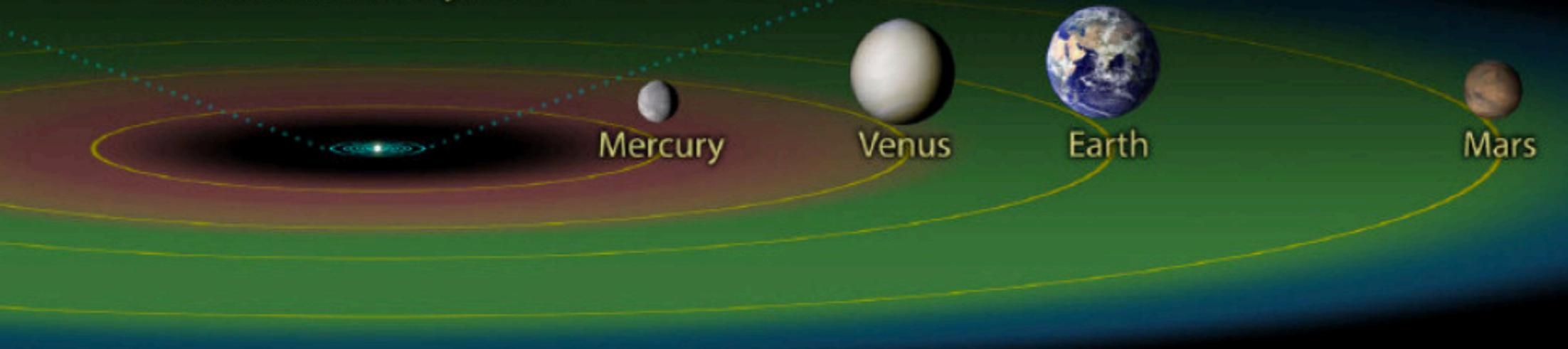




## TRAPPIST-1 System

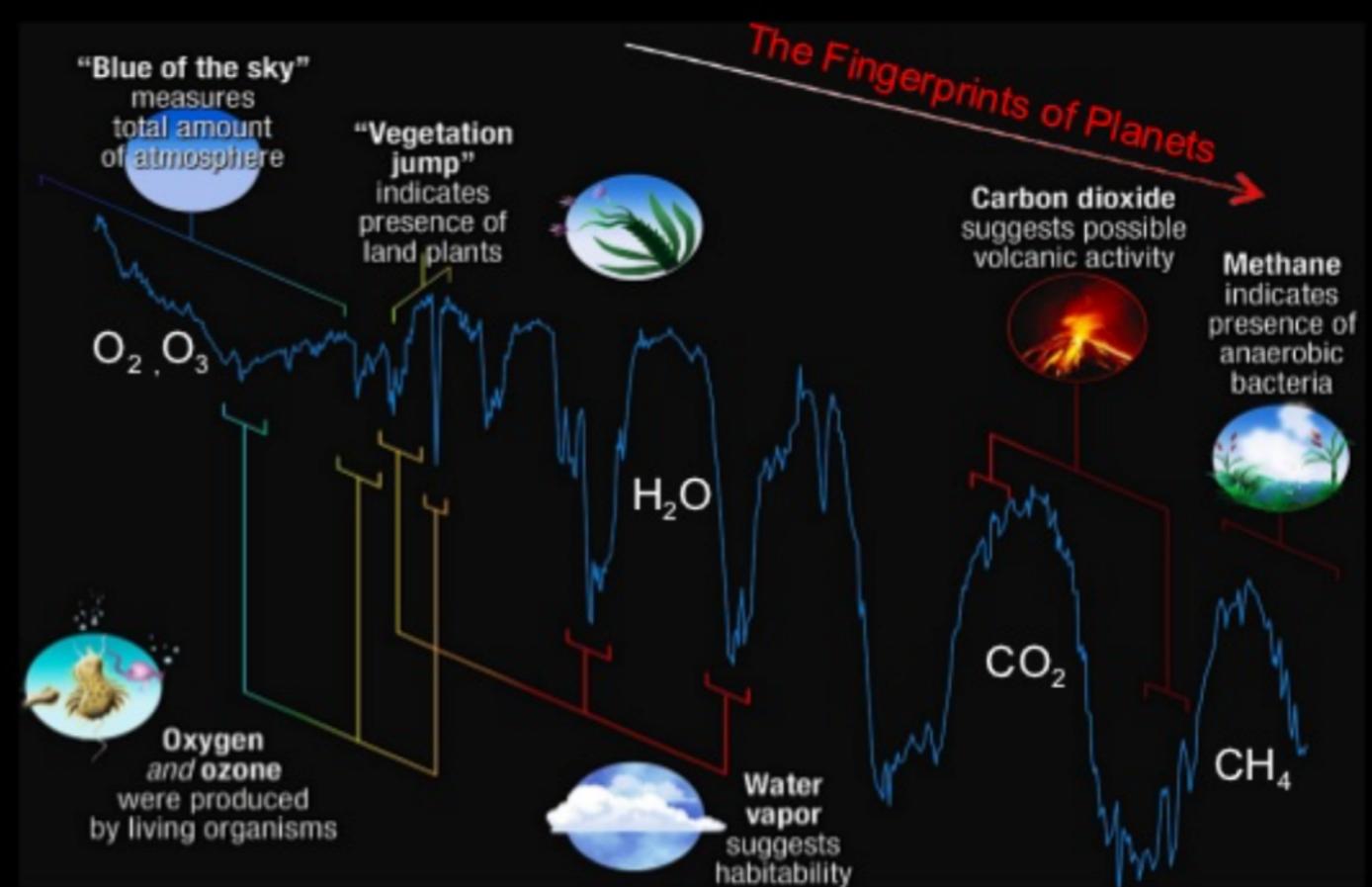
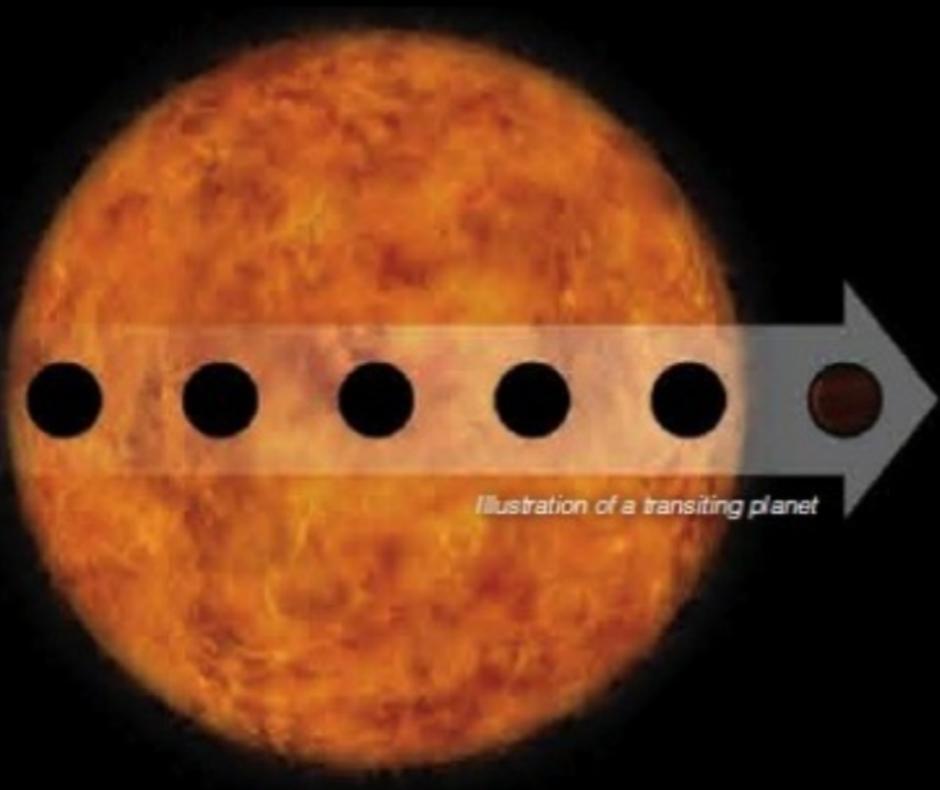


## Inner Solar System

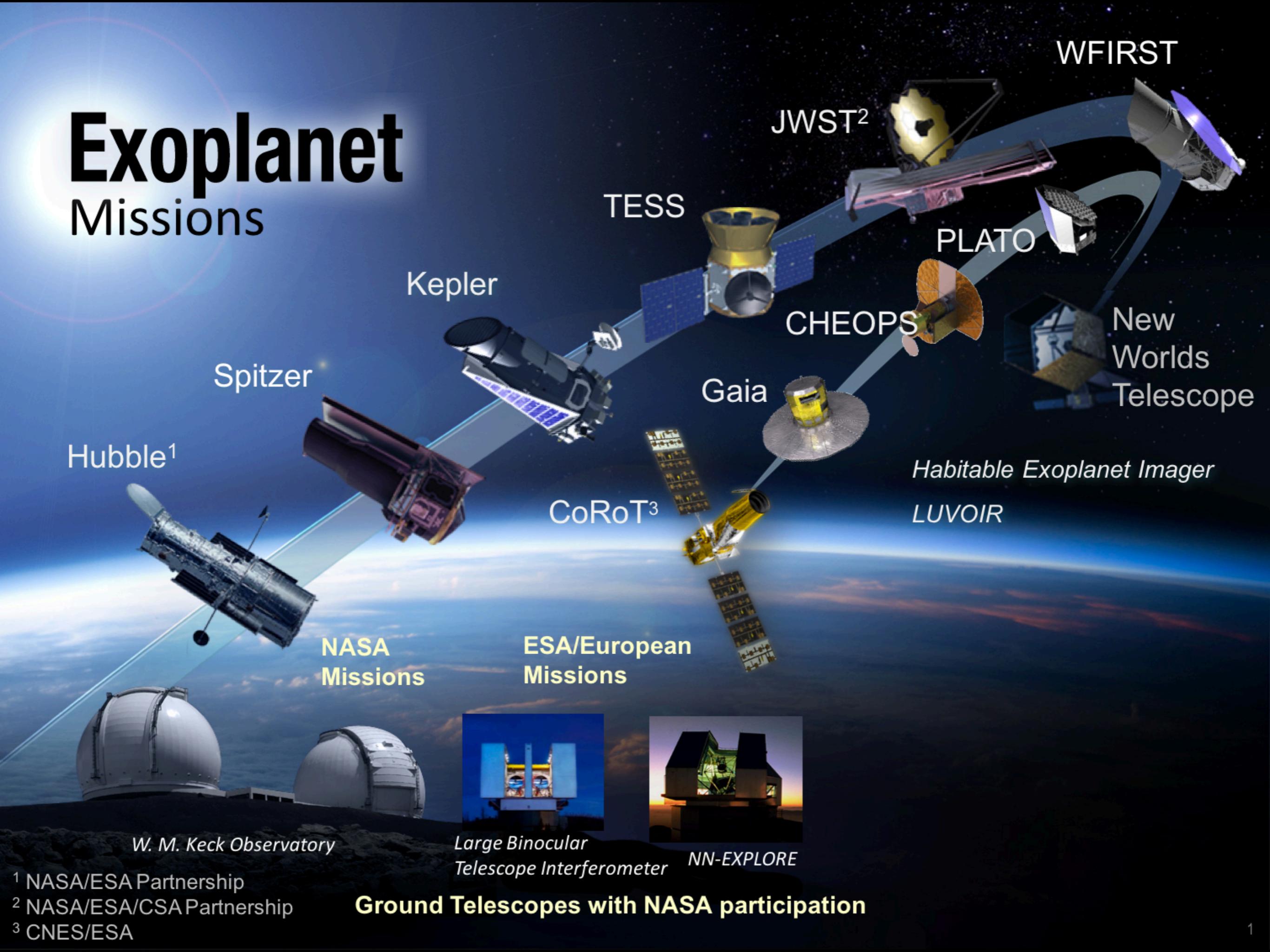


Illustration





# Exoplanet Missions



<sup>1</sup> NASA/ESA Partnership

<sup>2</sup> NASA/ESA/CSA Partnership

<sup>3</sup> CNES/ESA

*Are we alone?*



# NASA Budget as a Percentage of the US Federal Budget

